What is claimed is:

【Claim 1】

A smart pipette for bio-cell manipulation, which, together with a vision unit, a haptic unit, a control unit, a graphic user interface and a holding pipette, constitutes a micro manipulation device, comprising:

an orientation adjusting unit that changes orientation of a bio-cell whose location has been fixed by the holding pipette; and

a sensor unit that obtains force/torque information concerning the bio-cell and the smart pipette at the time of the bio-cell manipulation.

【Claim 2】

The smart pipette for bio-cell manipulation according to claim 1, wherein the orientation adjusting unit has same degree of freedom as the micro manipulation device and may change the orientation of the bio-cell.

【Claim 3】

The smart pipette for bio-cell manipulation according to claim 1, wherein the orientation adjusting unit is suitable for a living body.

【Claim 4】

The smart pipette for bio-cell manipulation according to claim 1, wherein the orientation adjusting unit is a polymer.

【Claim 5】

The smart pipette for bio-cell manipulation according to claim 1, wherein the orientation adjusting unit is located apart from a tip of the pipette at least by certain length that would make it not interfere with penetration into the bio-cell.

【Claim 6】

The smart pipette for bio-cell manipulation according to claim 1, wherein the orientation adjusting unit changes orientation of the bio-cell by using friction with the bio-cell.

【Claim 7】

The smart pipette for bio-cell manipulation according to claim 1, wherein the orientation adjusting unit changes orientation of the bio-cell when the holding pipette's force that holds the bio-cell has been weakened.

【Claim 8】

The smart pipette for bio-cell manipulation according to claim 1, wherein the sensor unit transmits the force/torque information real time to the haptic unit.

【Claim 9】

The smart pipette for bio-cell manipulation according to claim 1, wherein sensor unit is a piezo-electric polymer sensor.

【Claim 10】

The smart pipette for bio-cell manipulation according to claim 1, wherein the sensor unit is a cantilever type.

【Claim 11】

The smart pipette for bio-cell manipulation according to claim 2, wherein orientation adjusting unit changes orientation of the bio-cell to directions of x, y or z axes.

【Claim 12】

The smart pipette for bio-cell manipulation according to claim 4, wherein the polymer is polydimethylsiloxane (PDMS).

【Claim 13】

The smart pipette for bio-cell manipulation according to claim 8, wherein the force/torque information transmitted by the sensor unit is quantified and transmitted to the manipulating person real time through the graphic user interface.

【Claim 14】

The smart pipette for bio-cell manipulation according to claim 9, wherein the piezo-electric polymer is polyvinylidene fluoride (PVDF) film.

【Claim 15】

The smart pipette for bio-cell manipulation according to claim 1, further comprising a minute driver for minute manipulation of the smart pipette.

【Claim 16】

The smart pipette for bio-cell manipulation according to claim 15, wherein the minute driver conducts impact driving using the graphic user interface.

【Claim 17】

A bio-cell manipulation method using a smart pipette including a sensor unit, comprising:

(a) quantifying force/torque information acquired through the sensor unit during bio-cell manipulation;

(b) transmitting the quantified force/torque information to a graphic user interface; and

(c) manipulating the bio-cell based upon the force/torque information transmitted in said step (b).

【Claim 18】

The bio-cell manipulation method using a smart pipette according to claim 17, wherein the force/torque information quantified in said step (a) is measured by a piezo-electric sensor and then quantified.

【Claim 19】

The bio-cell manipulation method using a smart pipette according to claim 17, wherein in said step (b), the force/torque information is transmitted real time.

【Claim 20】

The bio-cell manipulation method using a smart pipette according to claim 17, wherein said step (c) comprises:

(d) comparing the quantified force/torque information with data acquired through prior experiments; and

(e) conducting the bio-cell manipulation based upon the comparison made in said step (d).

【Claim 21】

The bio-cell manipulation method using a smart pipette according to claim 20, wherein said step (e) is a step of acquiring information about in which layer of the bio-cell a tip of the smart pipette is located based upon the comparison made in said step (d).

【Claim 22】

A bio-cell manipulation system using a smart pipette comprising:

a sensory information receiver that acquires sensory information generated between the smart pipette and the bio-cell during the minute manipulation using the smart pipette; and

a measuring unit that receives the force/torque information from the sensory information receiver and quantifies such information.

【Claim 23】

The bio-cell manipulation system using a smart pipette according to claim 22, wherein the sensory information receiver comprises: a vision unit that acquires visual information of the smart pipette and the bio-cell; and

a haptic unit that acquires force/torque information between the smart pipette and the bio-cell.

【Claim 24】

The bio-cell manipulation system using a smart pipette according to claim 22, wherein the measuring unit displays the quantified force/torque information using a graphic user interface.

【Claim 25】

The bio-cell manipulation system using a smart pipette according to claim 22, wherein the measuring unit expresses the force/torque information as voltage.

【Claim 26】

The bio-cell manipulation system using a smart pipette according to claim 22, further comprising a control unit that controls the smart pipette operation based upon the force/torque information quantified at the measuring unit.

【Claim 27】

The bio-cell manipulation system using a smart pipette according to claim 26, wherein the control unit controls the smart pipette's location, operation speed and force required for operation, etc. of the smart pipette.